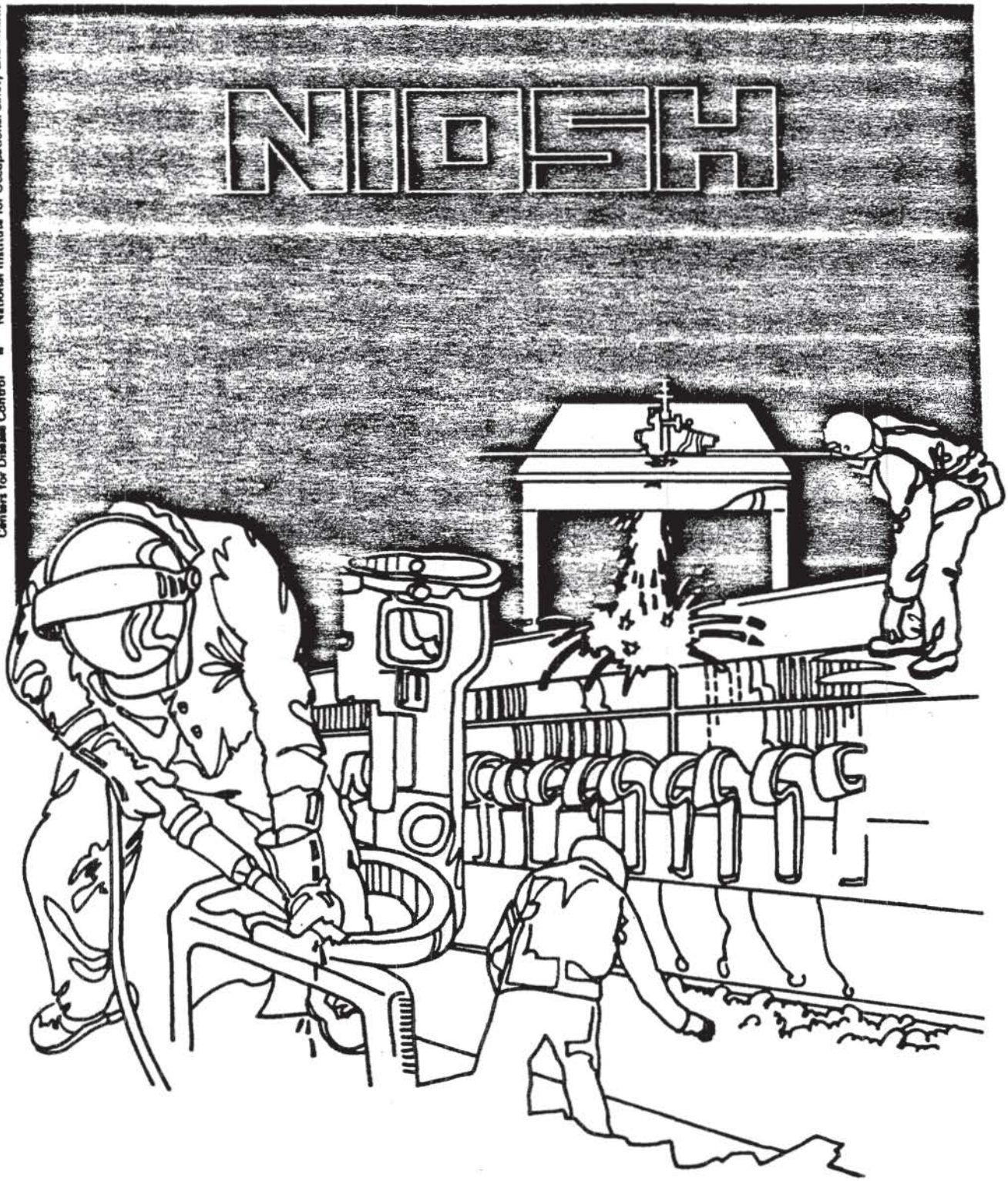
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health




# Health Hazard Evaluation Report

HETA 82-313-1221
USDA-FOOD AND NUTRITION SERVICE
BURLINGTON, MASSACHUSETTS

## PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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NIOSH INVESTIGATOR:
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## I. SUMMARY

On June 14, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the Safety Committee at the United States Department of Agriculture, Food and Nutrition Service, 33 North Avenue, Burlington, Massachusetts, to provide technical assistance in determining the cause of employee complaints of eye and sinus irritation. The request stated that the complaints began during this past winter.

NIOSH conducted a preliminary site visit on June 18, 1982, and a follow-up visit on July 13, 1982. Environmental monitoring consisted of 3 general area samples for formaldehyde, one area sample for determination of unspecified organics, and a ventilation survey. A health effects questionnaire was also administered to all employees.

Formaldehyde levels were below the limit of detection which was 5 micrograms per sample (0.01 ppm). No peaks were observed on the chromatogram for the unspecified organics sample.

Ventilation measurements indicated that total air volume in the building met or exceeded the design specifications. However, due to inacessibility of the roof units, no fresh air supply measurements could be taken. Calculations indicated that there was twice as much air movement per person on the Child Nutrition side of the building as there was on the Food Stamp side.

The results of the health effects questionnaire revealed that employees on the Food Stamp side of the building had twice the prevalence of symptoms as those on the Child Nutrition side, and tended to report more severe symptoms. The symptoms included eye and mucuous membrane irritation, headache, and fatigue.

NIOSH could not document the presence of airborne substances in concentrations sufficient to cause employee health problems. However, the results of the ventilation survey and the health effects questionnaire indicate that the cause of employee symptoms is related to inadequate dilution ventilation on the Food Stamp side of the building. Recommendations are made in the body of the report to increase the amount of fresh outside air admitted into the HVAC units.

KEYWORDS: SIC 9641, Indoor Air Pollution, Office Building, Closed Building Syndrome.

## I. INTRODUCTION

On June 14, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Safety Committee at the United States Department of Agriculture, Food and Nutrition Service, 33 North Avenue, Burlington, Massachusetts, to provide technical assistance in determining the cause of employee complaints of eye and sinus irritation. The request stated that the complaints began during this past winter and continue to exist.

An Interim Report was sent to the employer in June, 1982.

## II. BACKGROUND

The Food and Nutrition Service (FNS) employs around 125 persons in the GSA contracted Burlington office building. The building is approximately five years old with no openable windows. The FNS occupies most of the second floor of the two story brick and cinder block structure. Total floor space is roughly 10,000 square feet, with an 8' ceiling. Three air handling systems are located on the roof which recirculate the majority of the office air. The building occupants could not determine the percentage of outside air entering the systems. The air is tempered using natural gas in the winter and cooling coils in the summer. Humidity controls have not been determined by the employer.

Most of the complaints were said to be stemming from the north end of the building. The first floor of the building houses a laser company which was said to use chemicals in their operation. The remainder of the second floor houses the office of a construction company which built the building.

## III. EVALUATION DESIGN AND METHODS

NIOSH conducted a preliminary site visit on June 18, 1982. A walkthrough of the building was conducted and several affected employees were interviewed. A copy of the ventilation system blue print was obtained for determination of design specifications. The ventilation system design capacities were calculated and compared to ASHRAE Standard 62-1981.[1]

On July 13, 1982, NIOSH conducted environmental monitoring which consisted of 3 general area samples for formaldehyde and one general area sample for unspecified organics. The formaldehyde samples were analyzed according to NIOSH Method P&CAM 354, and the unknown sample was analyzed by Gas Chromatography using a flame ionizing detector.

NIOSH also performed ventilation measurements throughout the building to determine the actual rate of air circulation. Every exhaust duct in the building was measured. The amount of fresh outside air admitted to the system could not be measured during this survey because the building owner would not provide access to the roof units. Fresh air requirements were calculated for both sides of the building and related to the incidence of employee health complaints.

A health effects questionaire was distributed to all employees who currently work in the building. This questionaire investigated the presence of symptoms of headache, eye irritation, upper respiratory irritation, and fatigue among employees while at work. This questionaire also investigated histories of allergies, medications, and smoking.

## IV. EVALUATION CRITERIA

There are several possible causes for health complaints in office buildings. Poor lighting has been reported to cause headaches, extremely dry air has caused eye, nose and throat irritation, and air contaminants have produced a variety of responses in office personnel. The air contaminants of interest during this investigation are as follows.

### Formaldehyde

The primary health effects of exposure to formaldehyde are irritation of the respiratory tract, eyes, and skin. Eye and respiratory tract irritation has been reported in workers exposed to concentrations of less than 1 ppm.[2] Recent studies have found that formaldehyde induced nasal cancer in rats exposed to high levels (15 ppm) of formaldehyde over a long period of time.[3] An excess cancer risk in humans has not been observed; epidemiologic studies to investigate this possibility are planned. However, until such studies are completed, NIOSH recommends protecting employees by reducing formaldehyde exposure to the lowest feasible levels.

### Cigarette Smoke

The possible effects of cigarette smoke range from minor eye and throat irritations experienced by most people in smoke filled rooms to anginal attacks in some persons with coronary artery disease. Investigators have found an increasing frequency of eye, nose and throat irritation with increasing concentrations of smoke. Eye and nose irritation was more frequent than throat or respiratory irritation. These effects are also influenced by the humidity of the air, with the maximal effect in warm, dry air.[4] Chalazions: small benign tumors of the eyelids, are thought to be caused by high levels of irritating particulates in the air, and could result from cigarette smoke.

### Ventilation

The purpose of the ASHRAE standard is "to specify indoor air quality and minimum ventilation rates which will be acceptable to human occupants and will not impair health". The ASHRAE standard for office buildings in which smoking is allowed calls for a minimum of 20 cubic feet per minute per person (cfm/person) of outside air, to dilute the carbon dioxide produced by metabolism and expired air from the lungs, and to dilute cigarette smoke to acceptable levels.

## V. RESULTS AND DISCUSSION

### Environmental

No formaldehyde was detected on any of the three general area samples. The limit of detection was 5 micrograms per sample, equivalent to 0.01 ppm..

There were no peaks observed on the chromatogram for the unknown sample, which indicates that there are no measurable organic compounds present in the office air.

### Ventilation

The FNS building is essentially divided into two areas: Food Stamp and Child Nutrition. The ventilation on the Food Stamp side is accomplished by one 30 ton Heating, Ventilation and Air Conditioning (HVAC) Unit. The design specifications call for a total volume of 7,900 cubic feet per minute (cfm). NIOSH measured 8,192 cfm for that unit.

The Child Nutrition side utilizes 2 HVAC units for ventilation: One 15 ton unit and one 10 ton unit. The design specifications call for a total volume of 5,065 cfm. NIOSH measured a total volume of 9,207 cfm (almost double the design spec.).

The Food Stamp side of the building is set up to accommodate 93 employees. The amount of fresh outside air needed to meet the minimum ASHRAE requirement calculates as follows: 93 employees x 20 cfm/employee =1,860 cfm. This is equivalent to 22.7% of the measured total air volume.

The Child Nutrition side employs 51 employees, necessitating 1,020 cfm (51 x 20) fresh outside air to meet the minimum standard. This amounts to 11% of the measured total air volume.

Even the casual observer can easily see that there is approximately twice as much total air volume per person on the Child Nutrition side as there is on the Food Stamp side.

### Health Effects Questionaire

60 questionaires were completed and returned to NIOSH. Of that number, 36 were from females and 24 males. When broken down as to which side of the building the employees worked on, 42 indicated they worked on the Food Stamp side, while 18 indicated the Child Nutrition side. 23 (38%) indicated they were current smokers. Table I reports the frequency of each symptom and the percentage of respondents who reported the symptom. Table II reports the incidence and severity rates of health effects according to location in the building.

The results of the questionaire (Table II) indicate that the attack rate (% of employees reporting symptoms) is twice as high on the Food Stamp side of the building (79%) as on the Child Nutrition side (39%). Also the severity of health complaints is greater on the Food Stamp side (88% of affected employees reporting multiple symptoms, compared to 29% on the Child Nutrition side).

The percentage of respondents who are smokers is three times as high on the Food Stamp side as on the Child Nutrition side.

## VI. CONCLUSION

NIOSH could not document the presence of airborne substances in concentrations sufficient to cause employee health problems. However, the results of the ventilation survey and the health effects questionaire indicate that the cause of employee symptoms is related to inadequate dilution of cigarette smoke contamination on the Food Stamp side of the building.

The incidence of symptoms is directly proportional to the amount of air movement per employee. There is one half the volume of air per person on the Food Stamp side of the building as there is on the Child Nutrition side, and twice the percentage of employees reporting health effects. The severity of the reported symptoms is also worse on the Food Stamp side.

It is the opinion of the NIOSH investigator that there is insufficient fresh outside air being admitted into the HVAC units, and thus there is a potential for an accumulation of carbon dioxide and cigarette smoke within the building.

The predominance of irritative symptoms in Table I tend to bear out the conclusion that cigarette smoke and deficient air dilution are likely to be responsible for employee health complaints.

## VII. RECOMMENDATIONS

Have each of the HVAC units adjusted to bring in no less than 25% fresh outside air at all times.

Limit smoking to designated areas, preferably with a direct exhaust to the outside.

## VIII. REFERENCES

1. American Society of Heating, Refrigeration, and Air Conditioning Engineers, ASHRAE 62-1981, Ventilation for Acceptable Indoor Air Quality, 1981.

2. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to formaldehyde. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW publication no. (NIOSH) 77-126).

3. Chemical Industrial Institute of Toxicology, Progress Report on CIIT Formaldehyde Studies (January 16, 1980),. Leon Goldberg, President, Research Triangle Park, N.C.

4. Smoking and Health: A Report of the Surgeon General, DHEW publication No. (PHS) 79-50066, Washington, D.C., 1979

## IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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## X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. USDA Food and Nutrition Service, Burlington, Ma.
2. NIOSH, Region 01
3. OSHA, Region 01

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table I

Frequency and Percent of Sample (N=60) Reporting Each Symptom

| Symptom | # Reporting Symptom | % of Sample |
|---|---|---|
| Eye irritation | 32 | 53 |
| Headache | 28 | 47 |
| Fatigue | 19 | 32 |
| Nasal irritation | 19 | 32 |
| Sore, Dry Throat | 14 | 23 |
| Cough | 7 | 12 |
| Chalazions | 6 | 10 |

Other symptoms reported to a lesser extent include: wheezing, shortness of breath, and muscle pains.

Table II

Distribution and Percentage* of Symptoms by Location
* Food Stamp N=42, Child Nutrition N=18

| Symptom | # FS area | % | # CN area | % |
|---|---|---|---|---|
| Eye irritation | 27 | 64 | 5 | 28 |
| Headache | 23 | 55 | 5 | 28 |
| Fatigue | 16 | 38 | 3 | 16 |
| Nasal irritation | 17 | 40 | 2 | 11 |
| Sore, Dry throat | 11 | 26 | 3 | 16 |
| Cough | 6 | 14 | 1 | 6 |
| Chalazions | 4 | 10 | 2 | 11 |
| Smokers | 20 | 48 | 3 | 16 |
| # reporting any symptom | 33 | 79 | 7 | 39 |
| # w/ multiple symptoms | 29 | 69 | 2 | 11 |